

## Determination of relative reactivities of metals through displacement reactions

### Introduction

Some metals are more reactive than others. In this experiment, a piece of metal is added to a solution of a compound of another metal. A more reactive metal displaces a less reactive metal from its compound. By carrying out this experiment, you will be investigating the competition reactions of metals and produce a reactivity series of the metals.

### Apparatus

dimple tray

100 cm<sup>3</sup> beaker

4 × dropping pipettes

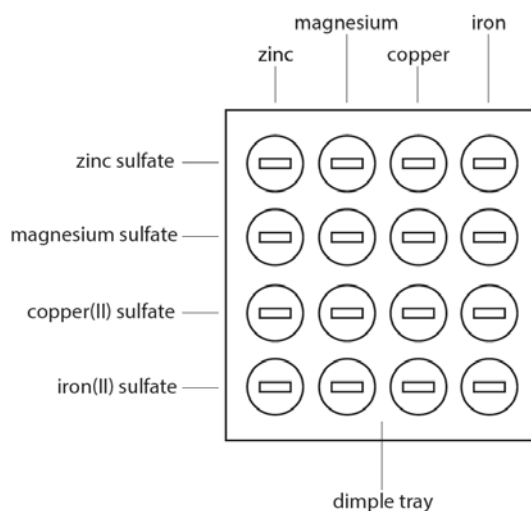
5 cm<sup>3</sup> of each of the following at 0.1 mol/dm<sup>3</sup>

- zinc sulfate
- magnesium sulfate
- copper(II) sulfate
- iron(II) sulfate

Approximately 1 cm length/square sample of the following metals.

- zinc
- magnesium
- copper
- iron

### Diagram of Apparatus



## Method

1. Using a dropping pipette, put a little zinc sulfate in four of the depressions of the dropping tile. Do this for each solution in turn. Do not overfill dimples.
2. Put a piece of metal in each of the solutions, using the apparatus diagram as a guide.
3. Observe and record the changes in the solutions or metal samples.

## Analysis

1. Use your results to construct a reactivity series for the metals used. Write equations for any reactions that occurred.

## Risk Assessment

Hazard	Risk	Control measure
Salt solutions are harmful	Whilst dispensing the solutions they can be squirted into eyes or if spilt onto hands, solutions can be transferred to eyes	Wear eye protection Wash hands when solutions spilt on to hands

## Teacher / Technician notes

### Reagents

- Zinc sulfate - Refer to CLEAPSS hazard card 108
- Magnesium sulfate - Refer to CLEAPSS hazard card 59B
- Copper(II) sulfate - Refer to CLEAPSS hazard card 27B
- Iron(II) sulfate - Refer to CLEAPSS hazard card 38
- Zinc foil - Refer to CLEAPSS hazard card 107
- Magnesium ribbon - Refer to CLEAPSS hazard card 59A
- Copper foil - Refer to CLEAPSS hazard card 26
- Iron - Refer to CLEAPSS hazard card 38

Solutions may be dispensed in small beakers to each group of students or in small dropper bottles.

Students may need two dimple trays per group, if trays do not contain 16 dimples.

Metals should be approximately 1 cm lengths/squares of ribbon or foil cleaned with an emery cloth and as similar in size as possible.

Students will need to record which metals react with the solutions. A table may be useful. Use a ✓ to show reactivity and a X to show no reaction. The metals with the most ticks are the most reactive.

Students should design their own table, but a suggested table format is shown below.

	Zinc	Magnesium	Copper	Iron
Zinc sulfate				
Magnesium sulfate				
Copper(II) sulfate				
Iron(II) sulfate				

You can point out to students that there is no need to carry out the zinc/zinc sulfate, magnesium/magnesium sulfate reactions, etc or allow them to decide for themselves if these reactions are likely to lead to a positive result.

Remind students that they are looking for metal displacement, some solutions are slightly acidic so bubbles of hydrogen can be seen. Explain that this doesn't count as displacement. Students may need to be given guidance of the sort of observations they may expect to see.

It may be best to get the class to tell you what they think the order of reactivity is while they still have the evidence in front of them, so that discrepancies can be resolved.

There are many ways of carrying out this series of reactions. The one described here uses a dimple tray, but it can be adapted with test tubes. The advantages of the dimple tray are the small amounts of chemical involved and the way the results are displayed.

## Working scientifically skills covered

### **2. Experimental skills and strategies**

Make and record observations and measurements using a range of apparatus and methods.

### **3. Analysis and Evaluation**

Present observations and other data using appropriate methods.

Interpret observations and other data including identifying patterns and trends, making inferences and drawing conclusions.